

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
6 November 01

3. REPORT TYPE AND DATES COVERED
Technical Report 9/99 - 11/01

4. TITLE AND SUBTITLE

Acceptability of Carbohydrate Gels During a 5-Day U.S. Marine Corps Basic Officer Course Field Exercise

5. FUNDING NUMBERS

6. AUTHOR(S)

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8. PERFORMING ORGANIZATION
REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Same as Block # 7

10. SPONSORING / MONITORING
AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release - distribution unlimited.

20020114 006

13. ABSTRACT (Maximum 200 words)

Warfighters typically undereat relative to their energy expenditure during field training and deployments. Carbohydrate supplements in liquid and solid form provide a means of enhancing carbohydrate and total caloric intake when soldiers are likely to consume insufficient rations. Liquid and solid carbohydrate ration supplements have been developed for use by the U.S. military. Commercial carbohydrate gels, used by the sporting community but not by the military, were assessed for acceptability with regard to taste, texture, and how likely soldiers or Marines would use them during a 5-day field exercise. Fifty Marines were provided 2 packets per day of commercial carbohydrate gels (Power Gel, Power Par, Inc., Berkeley, CA, and GU, Sports Street Marketing, Berkeley, CA) and completed a questionnaire on the acceptability of carbohydrate gels they either consumed or sampled at the end of their training exercise. This was not a controlled study, but rather a market assessment of the potential use of gels while training or deployed. Not all Marines consumed all flavors, and the order of consumption was not controlled or monitored. The Marines rated the carbohydrate gels as moderately acceptable, and 84% of Marines thought they were "very likely" or "extremely likely" to use them in the field, particularly when relying on Meals, Ready-to-Eat (MREs) as the primary source of food. Carbohydrate gels were not rated as highly as ERGO Drink, a carbohydrate beverage powder. The ERGO Drink ratings were from a previous study with Marines undergoing similar training. The commercial tear-top packages present problems for use by the military because of 1) disposal problems, 2) all the gel would have to be consumed immediately after opening because the package cannot be resealed, and 3) the potential leakage of the product if package is torn. In conclusion, commercial carbohydrate gels were moderately acceptable but do not compare favorably with ERGO Drink. The current packaging is unacceptable for military use.

14. SUBJECT TERMS

Carbohydrate Gels, Acceptability, Energy Intake, Carbohydrate Intake, Exercise, Diet, Field Rations, Sustained Operations

15. NUMBER OF PAGES
29

16. PRICE CODE

17. SECURITY CLASSIFICATION
OF REPORT

Unclassified

18. SECURITY CLASSIFICATION
OF THIS PAGE

Unclassified

19. SECURITY CLASSIFICATION
OF ABSTRACT

Unclassified

20. LIMITATION OF ABSTRACT

USARIEM TECHNICAL REPORT TXX-X

**ACCEPTABILITY OF CARBOHYDRATE GELS DURING A 5-DAY U.S. MARINE
CORPS BASIC OFFICER COURSE FIELD EXERCISE**

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November 2001

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ACKNOWLEDGEMENTS

The authors wish to thank the Marines of the Infantry Officer Course, Class 3-00, of The Basic School, Marine Corps Combat Development Command, Quantico, VA, for their participation in the study; the Marine Corps Basic School for their dedicated support prior to and during data collection; The U.S. Marines Corps for their financial support; SGT Kevin Warren and Mr. Mark Buller for their technical support; and Ms. Theresa Skibinski and Dr. Shelley Strowman for their help in developing the carbohydrate gel questionnaire.

EXECUTIVE SUMMARY

Warfighters typically undereat relative to their energy expenditure during field training and deployments. Carbohydrate supplements in liquid and solid form provide a means of enhancing carbohydrate and total caloric intake when soldiers are likely to consume insufficient rations. Liquid and solid carbohydrate ration supplements have been developed for use by the U.S. military. Commercial carbohydrate gels already widely used by the sporting community but not by the military, were assessed for acceptability with regard to taste, texture, and how likely soldiers or Marines would use them during a 5-day field exercise. Fifty Marines were provided 2 packets per day of commercial carbohydrate gels (Power Gel[®], PowerBar[®], Inc., Berkeley, CA, and GU[®], Sports Street Marketing, Berkeley, CA) and completed a questionnaire on the acceptability of carbohydrate gels they either consumed or sampled at the end of their training exercise. This was not a controlled study, but rather a market assessment of the potential use of gels while training or deployed. Not all Marines consumed all flavors, and the order of consumption was not controlled or monitored. The Marines rated the carbohydrate gels as moderately acceptable, and 84% of Marines thought they were "very likely" or "extremely likely" to use them in the field, particularly when relying primarily on Meals, Ready-to-Eat (MREs) as the primary source of food. Carbohydrate gels were not rated as highly as ERGO Drink, a carbohydrate beverage powder. The ERGO Drink ratings were from a previous study with Marines undergoing similar training. The commercial tear-top packages present problems for use by the military because of 1) disposal problems, 2) all the gel would have to be consumed immediately after opening because the package cannot be resealed, and 3) the potential leakage of the product if package is torn. In conclusion, commercial carbohydrate gels were moderately acceptable but do not compare favorably with ERGO Drink. The current packaging is unacceptable for military use.

INTRODUCTION

Warfighters working in field environments typically undereat relative to their caloric expenditure (1), and carbohydrate utilization. The shortfall in total energy intake is normally met by drawing from ample body fat reserves. In contrast, body carbohydrate reserves are modest, and inadequate carbohydrate intake in these physically active individuals leads to decreased carbohydrate reserves (1,9,11). Low carbohydrate availability negatively affects physical performance (8,10). Soldiers may experience unnecessary loss of muscle mass and other problems due to inadequate carbohydrate intake when exercising vigorously (<300 g/d) (4,6,8,9,11). The use of carbohydrate drink supplements in U.S. Army Rangers has been shown to increase cognitive performance on an auditory vigilance-reaction time test and improvements in mood after a 19.3 km road march followed by two 4.8 km runs with intermittent rest periods (5). Carbohydrate drinks also improved U.S. Army Rangers' performance on physical tasks such as uphill running and marksmanship immediately following uphill running (8). To help meet the need for supplemental carbohydrate, a memorandum from the USARIEM Commander to the Director of Sustainability Directorate at the U.S. Army Natick Research and Engineering Center requested that 100-200 g/man/d of supplemental carbohydrate be provided in rations to reduce problems associated with low levels of carbohydrate intake (December 12, 1996).

RATIONALE FOR ASSESSMENT

Recently, ERGO Drink, a powdered carbohydrate beverage designed at the Soldier Systems Center, U.S. Army Biological Chemical Command, Natick, MA was evaluated. It has received high ratings for flavor and packaging and was rated as a valuable product for field-deployed troops (7). Scientists at the Soldier Systems Centers were also interested in the potential use and acceptance by military personnel of another form of a carbohydrate supplement, carbohydrate gels. To meet that need, this assessment was undertaken with U.S. Marines participating in a combat field training exercise. This assessment was not a controlled study, but rather was a market assessment of the potential interest among warfighters deployed to the field in receiving carbohydrate supplementation in this form. The word "assessment" will be used throughout this report to distinguish this research from a controlled research study. Volunteers responding to the questionnaire shown in the appendix may be viewed as potential consumers of a gel product if developed. This assessment simply asked respondents to provide feedback on some commercial gels they were provided during their training. These gels are currently available in most specialty sporting goods stores. This assessment was part of a larger on-going study examining the physiological status of Marines while participating in the training exercise.

Carbohydrate gels are relatively new products marketed to endurance athletes. These products provide a concentrated source of carbohydrate (100-110 kcal per 32-41 g package) in a form that is easy to consume during physical activity. Several flavors are available. Whether Marines and soldiers would find them acceptable during field operations when other food items are available was unknown.

METHODS

SUBJECTS

Fifty students (46 men and 4 women) from Company C, Basic Officer Course (BOC) Class 3-00, The Basic School (TBS), Marine Corps Combat Development Command, Quantico, VA, volunteered to participate in this assessment. During the evaluation, they participated in a 5-day field exercise. The Marines were informed of the purpose and methodology of this assessment prior to beginning the field exercise and gave their informed consent.

EXPERIMENTAL DESIGN

At the beginning of the exercise, Marines were provided a sufficient quantity of carbohydrate gels to enable each Marine the opportunity to consume two packets per day. They were issued the packets prior to the field exercise. No restrictions were placed on the number of packets per day or time of day they could be consumed. The Marines were asked to consume the gels during the exercise and provide feedback via a questionnaire after five days of sampling on whether they consumed the gels and to provide acceptability ratings on those gels tried or consumed.

The field exercise consisted of daily force-on-force operations designed to develop leadership skills during combat-like conditions. Daily activities included planning and preparation, combat maneuvers, and a debriefing. Sleep periods ranged from several hours per day during the initial day of the operation to short naps during the final days of the exercise. The daily caloric expenditure was approximately 4100 kilocalories per day as measured by the doubly labeled water method (R.W. Hoyt, unpublished, May 2001). The Marines were provided five Meals, Ready-to-Eat (MREs) at the beginning of the field exercise, thus limiting caloric intake from MREs to approximately 1300 kilocalories per day.

The carbohydrate gels tested were two of the most popular brands on the market, Power Gel[®] (PowerBar[®], Inc., Berkeley, CA) and GU[®] (Sports Street Marketing, Berkeley, CA). Each Marine received the same number and flavors of the gels (one of each flavor). The flavors were Power Gel[®] Vanilla, Power Gel[®] Strawberry/Banana, Power Gel[®] Lemon-Lime, Power Gel[®] Chocolate, GU[®] Orange Burst, GU[®] Tri Berry, GU[®] Just Plain, GU[®] Chocolate Outrage, GU[®] Vanilla Bean, and GU[®] Banana Blitz. The two products were packaged in similar soft foil packages with a tear top. The shape of the package differed somewhat between the commercial vendors, as did portion size (Power Gel[®] = 41 g; GU[®] = 32 g). The amount of carbohydrate was 28 g for Power Gel[®] and 25 g for GU[®]. Neither gel contained protein or fat. No verbal instructions were given regarding how to consume the gels, but on the package of both brands were instructions to "tear off top, squeeze into mouth, follow with a few mouthfuls of water."

Following completion of the course, Marines completed a questionnaire (see Appendix) regarding acceptance and utility of the product, and some background questions regarding demographics, questions about how they felt about military food rations, and reported supplement use.

STATISTICAL ANALYSIS

Most of the data are presented as means \pm standard deviations (SD). When mean and median responses are presented together, the following format is used: means \pm SD, median =. Differences in the number of responses ($n=$) are shown because not all volunteers tried each gel flavor and/or they did not answer all questions. Frequencies are presented for categorical data. Two analyses of variance were conducted, one on each brand, Power Gel[®] and GU[®], with Least Significant Differences post hoc comparison tests used to isolate differences to determine preferred flavor for that brand. A paired sample T-Test on the overall acceptability of the mean ratings for all Power Gel[®] and GU[®] flavors was done to determine the preferred gel brand.

RESULTS

SUBJECT CHARACTERISTICS

The Marines averaged 26 ± 3 years of age (range 22-38 years). Their self-reported supplement use is presented in Table 1. Twenty-nine of the 50 Marines (58%) reported that they used nutritional supplements. Of the 48 Marines providing information on vitamin use, 18 (38%) reported taking vitamin and/or mineral supplements at least once per week. Nine of 45 Marines (20%) who answered the question regarding amino acid and protein supplements reported using amino acid and/or protein supplement products one or more times per week.

The Marines were familiar with sports drinks, sports bars and carbohydrate gels. Thirteen of 47 Marines (28%) reported drinking carbohydrate sports drinks one or more times per week. An additional ten Marines (21%) consumed them on an occasional basis. Twenty-three of 47 Marines (51%) ate sports bars at least occasionally, while 9 Marines (21%) reported consuming carbohydrate gels at least once in a while. Examination of carbohydrate use in the form of drinks, bars, or gels revealed two Marines (4%) reported daily use of carbohydrate drinks. Sixteen Marines (32%) reported using one or more products one or more times per week, while 8 Marines (16%) reported only occasional use of any carbohydrate products.

A majority (38 of 50; 76%) of the test volunteers felt field rations met their nutritional needs. The most frequently written negative comments were that field rations did not contain enough food and/or calories (5 of 12 responses received), and that the ration was either too high in fat, or did not contain enough complex carbohydrates, protein, and/or vegetables ($n = 6$). Despite the overall feeling that field rations met their

nutritional needs, it is noteworthy that 45 of 50 Marines (90%) thought that supplements should be added to the current ration system.

Table 1. Nutritional supplement use.

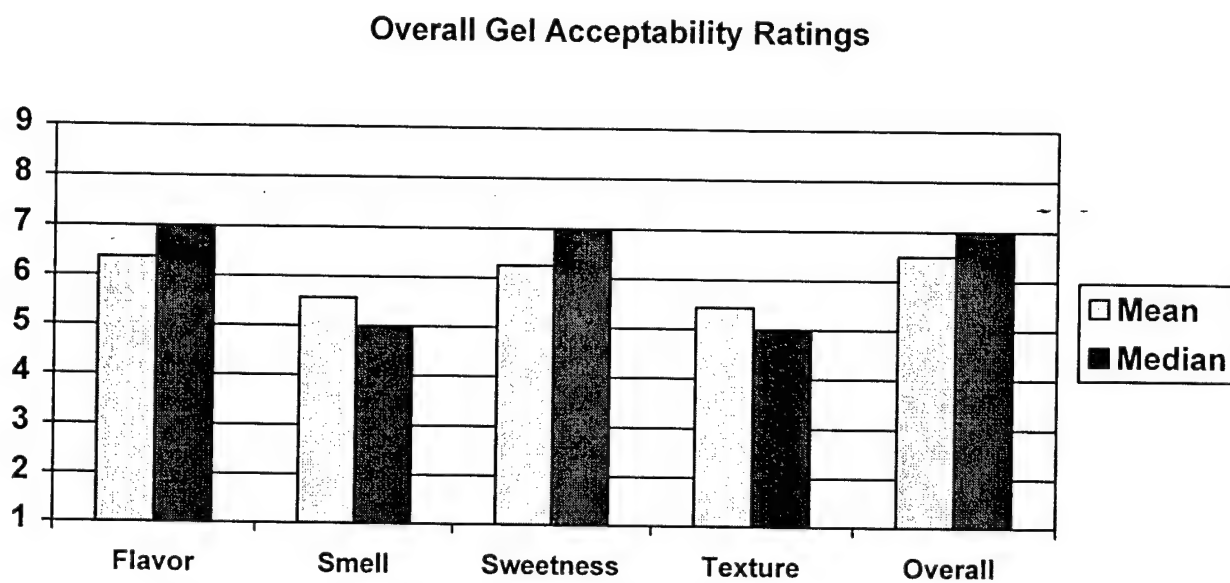
Supplement and Total Number Reporting* (n)	Frequency of Use % of Total Number Reporting			
	Never/ Hardly	Once in a While	1-6 Times Per Week	Once a Day
Vitamins/Minerals (48)	50.0	12.5	25.0	12.5
Amino Acid/Protein (Including Creatine) (45)	60.0	20.0	13.3	6.7
Herbal Preparations (41)	85.4	12.2	2.4	0.0
Carbohydrate/Electrolyte Beverages (47)	51.1	21.3	23.4	4.2
Carbohydrate Bars (45)	48.9	24.4	26.7	0.0
Carbohydrate Gels (43)	79.1	16.3	4.7	0.0

*Never/Hardly category includes all respondents who reported no supplement use at all, plus those that reported not using that particular supplement. The reported *n* of less than the total of 50 in this assessment corresponds to some volunteers who reported taking supplements but did not respond to the frequency of taking that particular supplement.

ACCEPTABILITY OF CARBOHYDRATE GELS

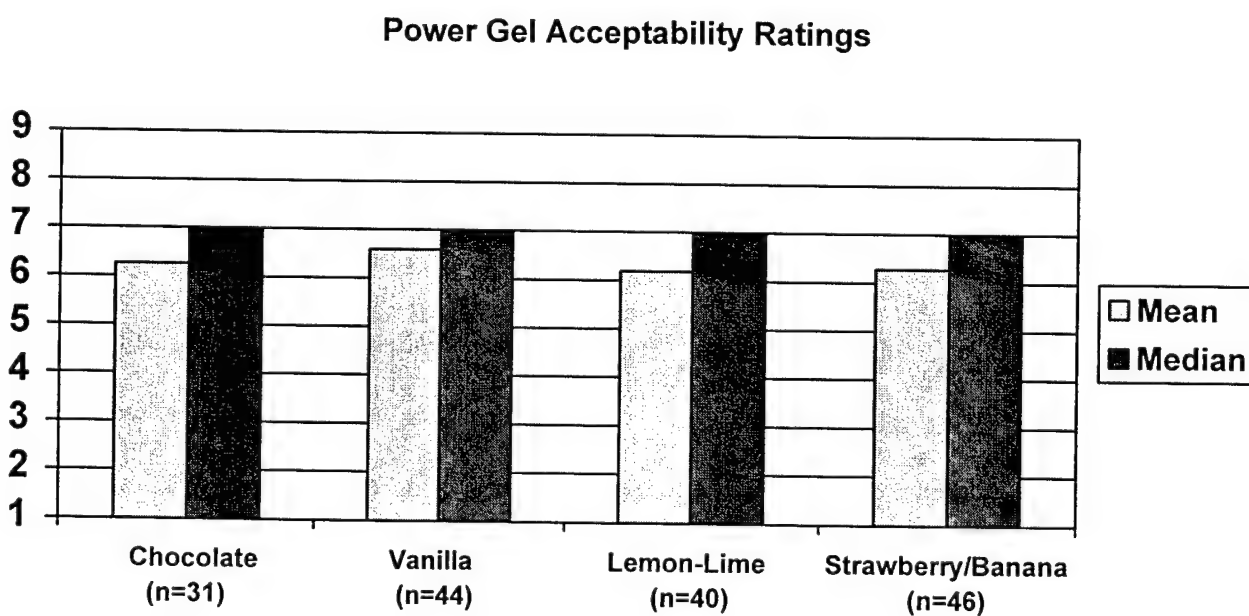
Figure 1 presents the mean and median responses regarding acceptability of the carbohydrate gels. Two Marines did not eat or try any of the gels or report acceptability ratings. Figures 2 and 3 present the mean and median responses for Power Gel® and GU®, respectively. The appearance, flavor, smell, sweetness, and texture of carbohydrate gels received mixed ratings. Figure 4 shows the frequency distribution for the likeability of gels on various product attributes. Twenty-five of 48 Marines (52%) were "neutral" regarding gel appearance; 12 Marines gave appearance unfavorable marks, and 9 Marines rated appearance favorably (giving an average rating of 5.0 ± 1.4). Most Marines (36 of 48) rated flavor positively, with a mean rating of 6.3 ± 1.8 . Smell received primarily "neutral" or higher marks, averaging a rating of 5.6 ± 1.5 . The Marines generally liked the sweetness of the gels, with 33 of 48 Marines (69%) reporting that they "slightly liked," "moderately liked," or "very much liked" the level of sweetness (a score of 6.3 ± 1.8). Texture received mixed scores, as some Marines

Figure 1. Mean and median responses (n=48) regarding gel acceptability.



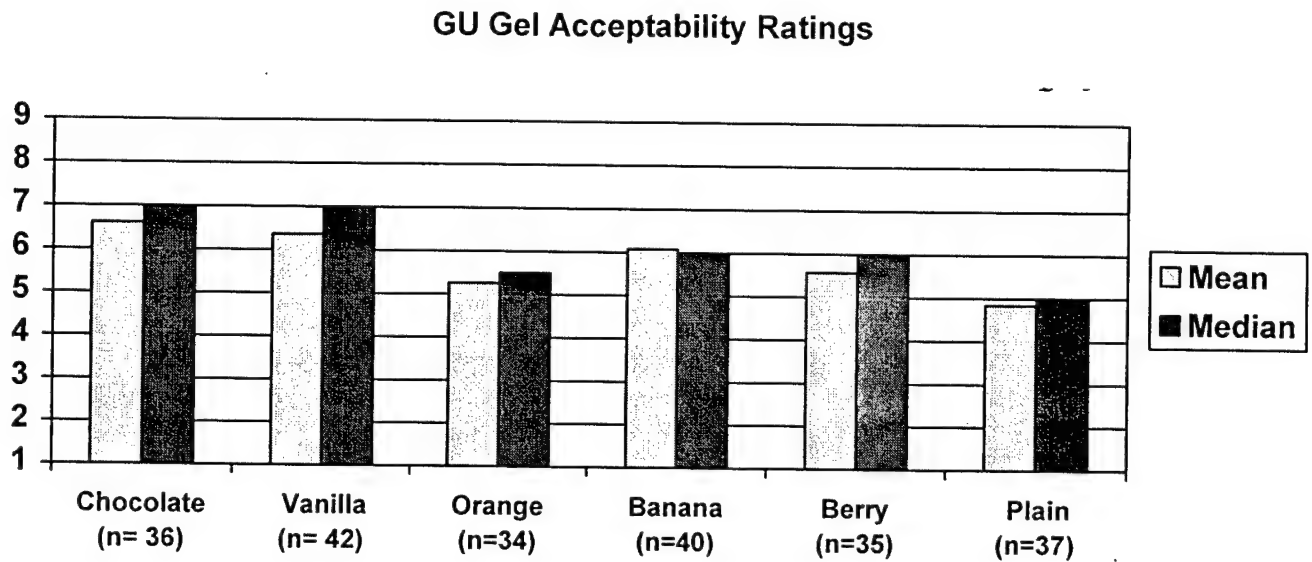
Rating: 1 = Dislike Extremely, 5 = Neither Like nor Dislike, 9 = Like Extremely

Figure 2. Mean and median responses of the various Power Gel[®] flavors.



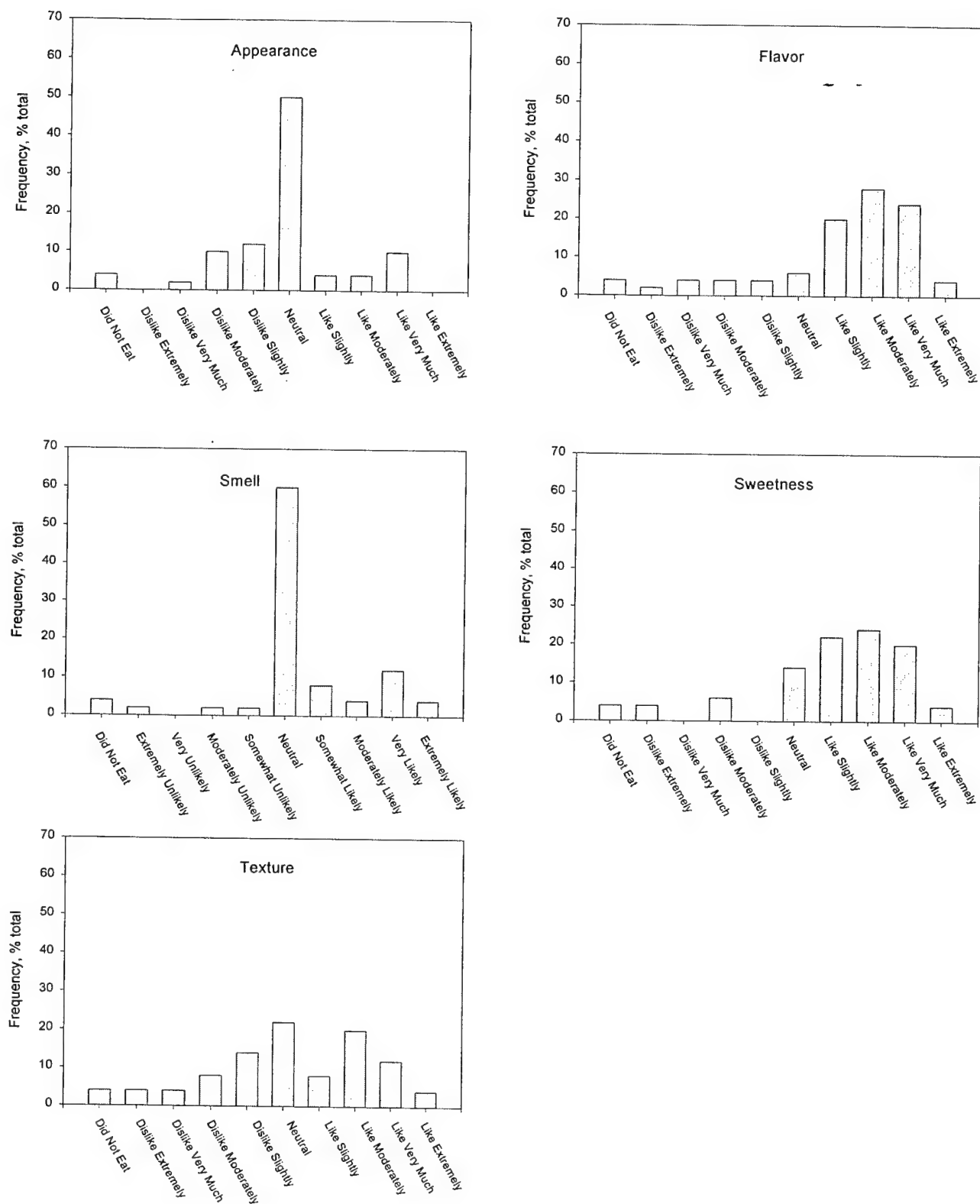
Rating: 1 = Dislike Extremely, 5 = Neither Like nor Dislike, 9 = Like Extremely

Figure 3. Mean and median responses of the various GU[®] flavors.



Rating: 1 = Dislike Extremely, 5 = Neither Like nor Dislike, 9 = Like Extremely

Figure 4. Frequency distribution for carbohydrate gel appearance, flavor, smell, sweetness, and texture for total number of respondents.



disliked the texture (15 of 48 less than "neutral"), while others, (22 of 48 Marines [46%]) rated texture positively. As a consequence, texture attained a mean rating of 5.4 ± 2.0 and a median of 5.0, respectively. A "5" rating represents "neither like nor dislike," while a rating of "6" represents "like slightly."

Overall, of those who consumed both brands ($n=45$), Power Gel® gels were rated significantly higher ($p<0.04$) with a 6.2 ± 1.8 rating compared to GU® gels, which were rated as a 5.7 ± 1.8 . No differences existed in ratings between Power Gel® flavors. A significant difference did exist between GU® flavors ($p<0.005$), with Chocolate ($n=36$) and Vanilla ($n=42$) rated significantly higher ($p<0.05$) than Orange ($n=34$) and Plain ($n=37$), while Banana ($n=40$) was rated higher ($p<0.05$) than Plain ($n=37$). Frequency distributions regarding the individual flavors varied depending on the brand and flavor consumed (Figures 5 and 6). All volunteers did not taste all the flavors provided during the field exercise, resulting in missing data for each flavor. The available data suggest that the Power Gel® Vanilla flavor was the most preferred flavor and was generally well liked, as 35 of 44 Marines (80%) who tried the flavor gave it favorable ratings, and 14 of 44 Marines (32%) liked the flavor "very much." A similar pattern also was present for the GU® Vanilla flavor, but it was less favorable than Power Gel® Vanilla. Only 5 of 42 Marines (12%) rated that they liked GU® Vanilla "very much."

GU® Chocolate received the highest proportion of ratings greater than "neutral," as 29 of 36 Marines (81%) rated this gel positively. However, while most of those who rated GU® Chocolate rated it positively, similar in proportion to Power Gel® Vanilla and slightly more than GU® Vanilla, there were 8 fewer ratings than Power Gel® Vanilla and 6 fewer ratings than GU® Vanilla suggesting that some Marines may not have liked the Chocolate flavor and did not try it.

The least acceptable gel was GU® Plain, as only 18 of 37 Marines (50%) rated it better than "neutral." Other flavors suggested were raspberry, strawberry-apple, grape, mocha, mocha-coffee, and flavors like those in yogurt. When Marines were asked if they thought a carbohydrate gel would be a valuable supplement, 28 of 49 Marines (57%) gave ratings of "very likely" or "extremely likely" that they thought it would be a valuable supplement (Figure 7). When asked, "If gels were provided in addition to rations, would you consume them," 38 of 49 Marines (78%) gave ratings of "very likely" or "extremely likely" that they would consume them (Figure 7).

Figure 5. Frequency distribution for acceptability ratings for various Power Gel® flavors for total number of respondents.

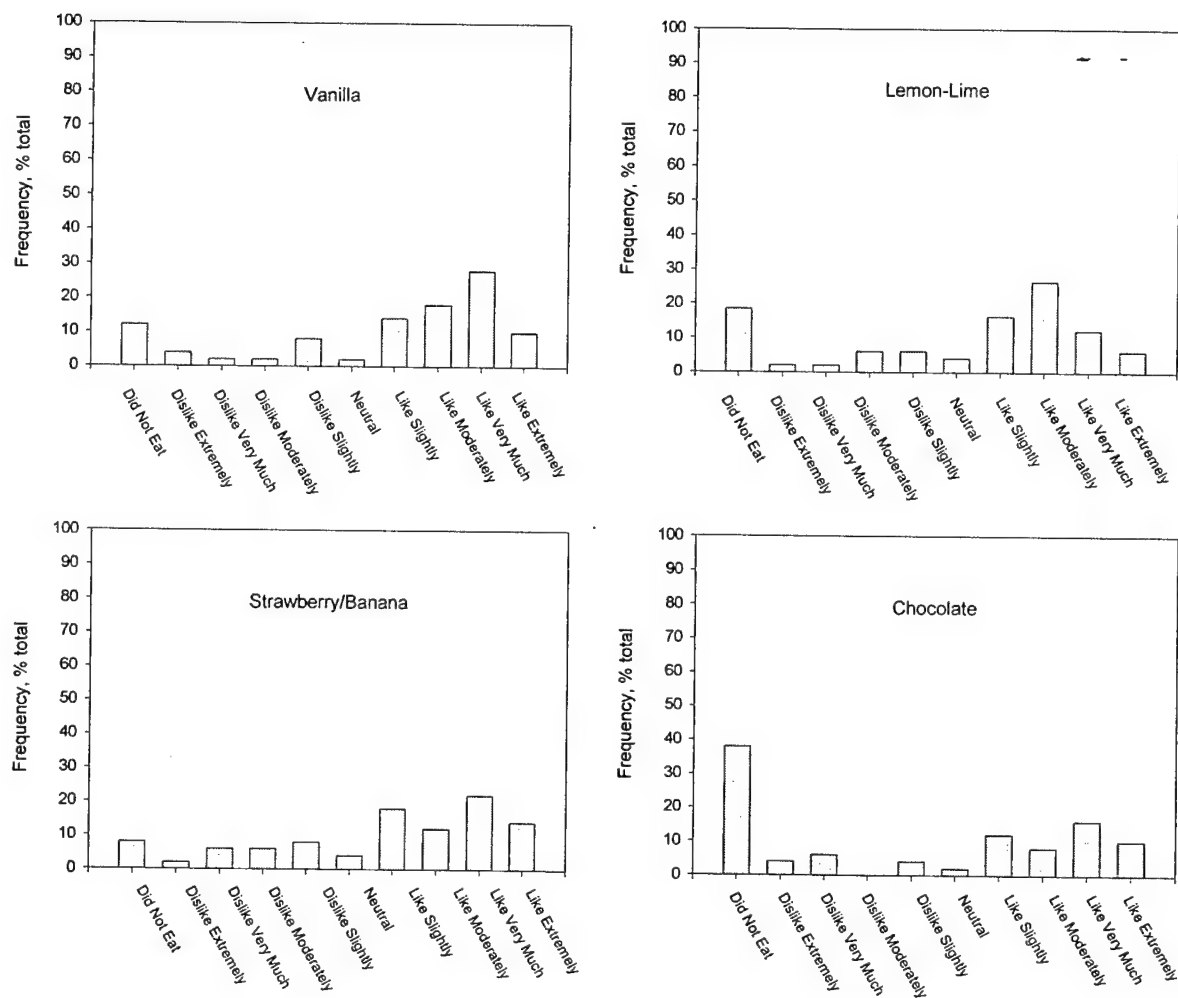


Figure 6. Frequency distribution for acceptability ratings for various GU[®] flavors for total number of respondents.

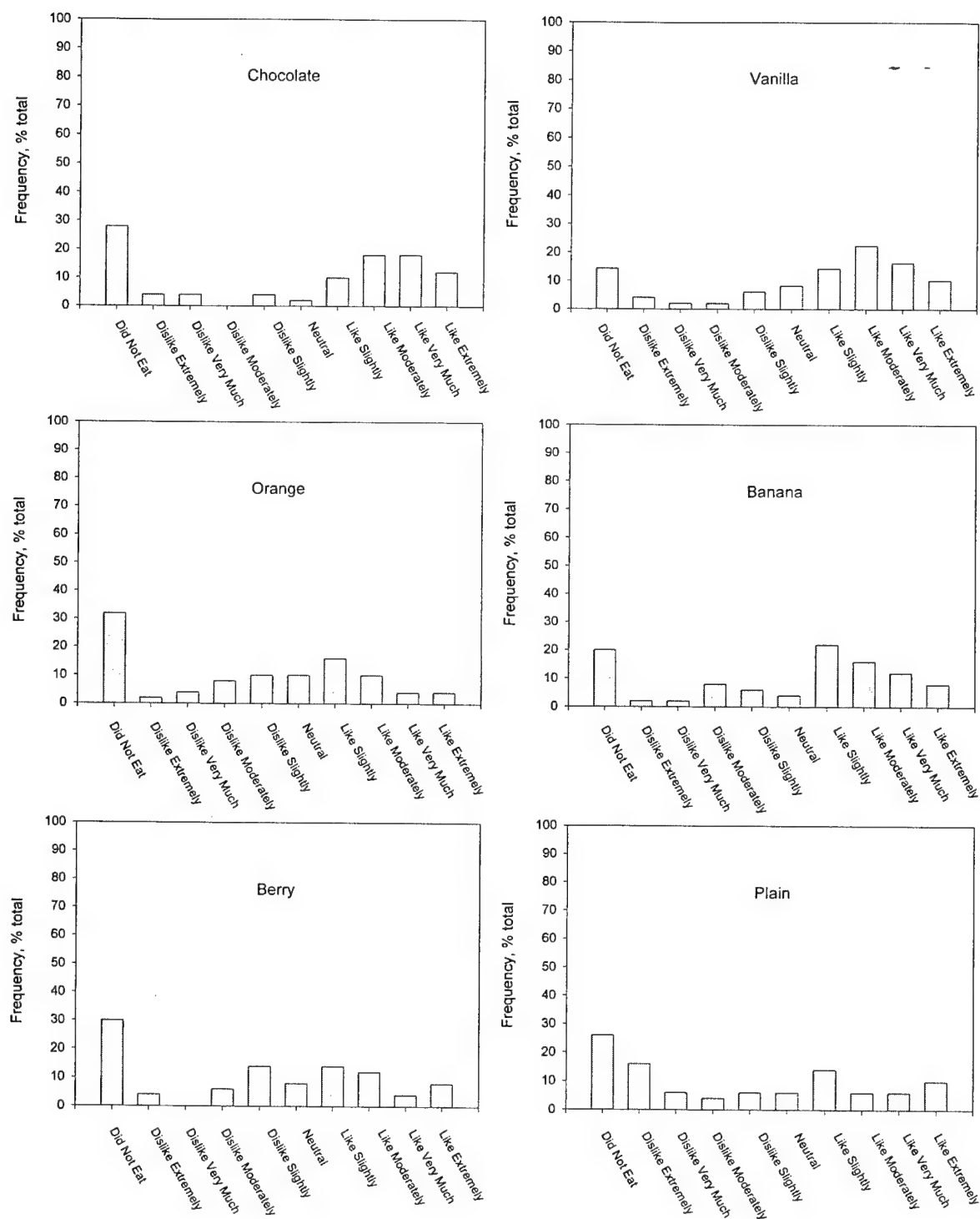
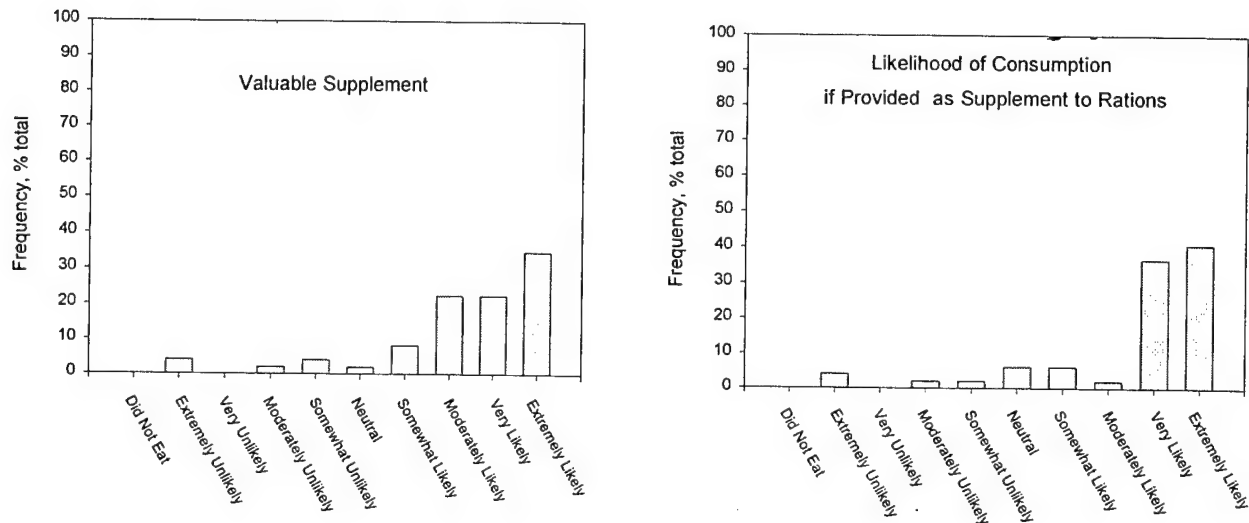


Figure 7. Frequency distribution of utility of carbohydrate gels and likelihood of consumption for total number of respondents.

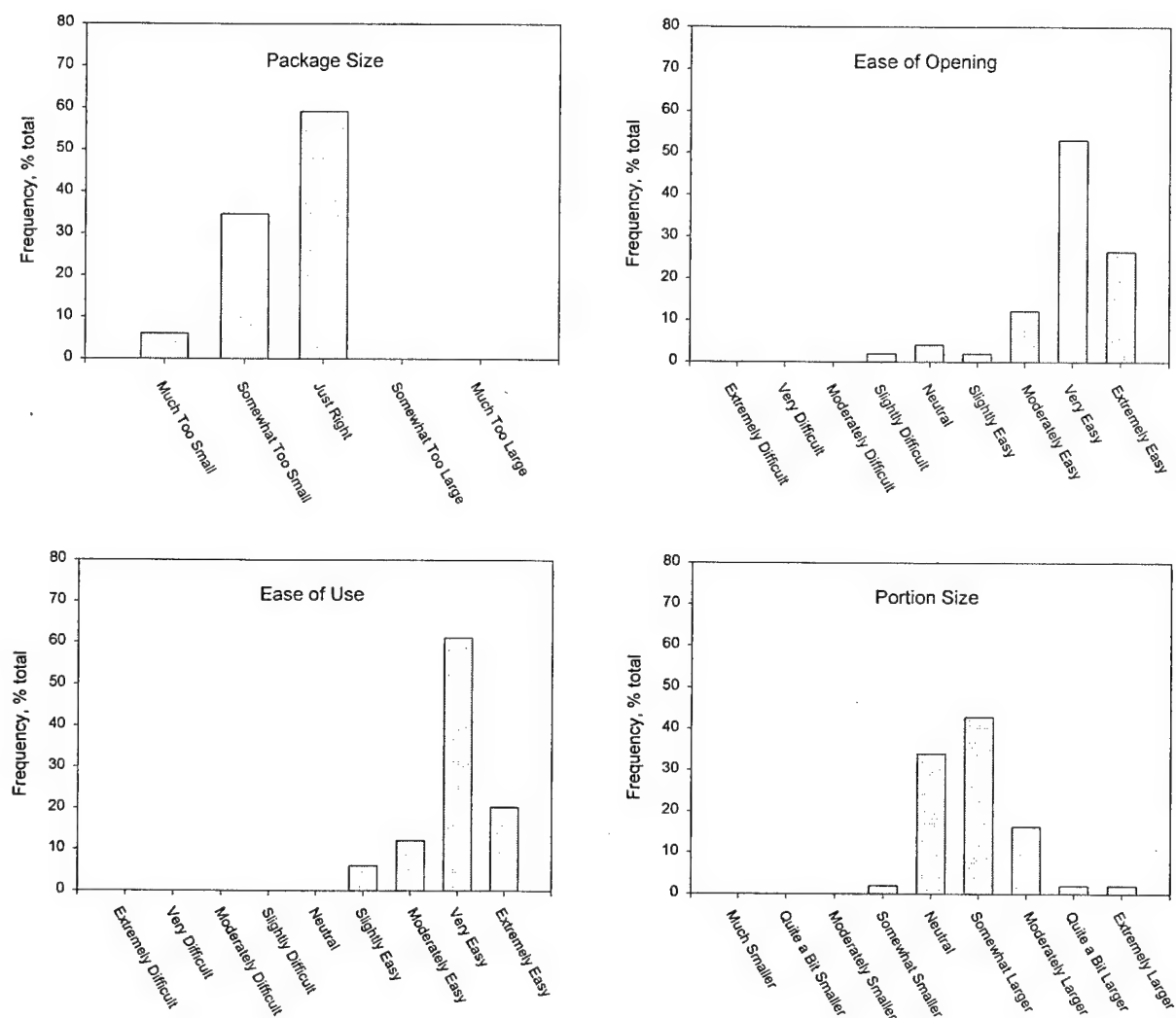


ACCEPTABILITY OF CARBOHYDRATE GEL PACKAGING

Figure 8 illustrates the frequency distribution of responses regarding the carbohydrate gel packaging. The package was rated as "very easy to open" (7.9 ± 1.1 ; median = 8.0), as well as "very easy to use" (8.0 ± 0.8 ; median = 8.0). The package size was rated "just right" in size by 29 of 49 Marines (59%) while 20 Marines (35%) felt the package was too small. Marines generally felt the portion size was adequate, but would prefer a somewhat larger size (5.9 ± 0.9 ; median = 6.0). Twenty-nine of 48 Marines (60%) preferred a soft package to a hard package. However, 15 of 48 Marines (31%) preferred a toothpaste-like tube to the tear-top design provided.

The frequency distributions regarding expected use of carbohydrate gels in selected military venues are presented in Figure 9. For use in garrison, 20 out of 49 Marines (41%) thought that gel use was "somewhat likely" or greater. However, a mean rating of 4.6 ± 2.6 and a median rating of 5 was obtained where "5" corresponds to a "neutral" rating. A similar pattern of responses, 31 of 49 Marines (63%), also existed when queried regarding use when a field kitchen was available for meals, with mean and median scores of 5.6 ± 2.6 , median = 6. In contrast, 41 of 49 Marines (84%) felt it "very likely" or "extremely likely" they would consume the carbohydrate gels when relying on the MRE as their primary food source. Furthermore, Marines ($n=49$) expected that the gels would be most commonly consumed during physical training (7.2 ± 2.3) vs. during rest (5.2 ± 2.7) or with meals (4.7 ± 2.4). A "7" rating corresponds to a "moderately likely" response.

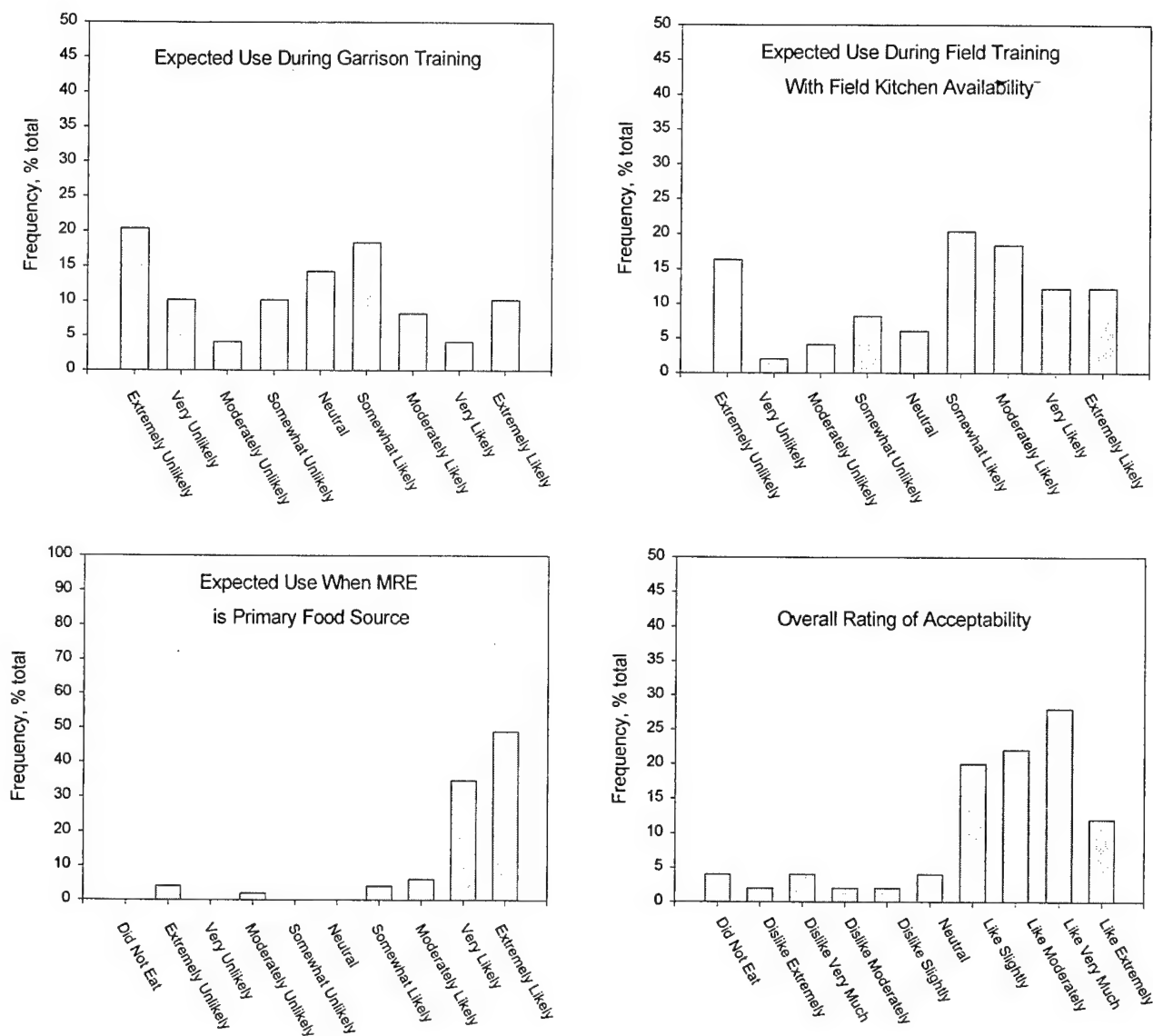
Figure 8. Frequency distribution of acceptability of carbohydrate gel packaging and portion size for total number of respondents.



OVERALL RATING OF CARBOHYDRATE GELS

The carbohydrate gels received an overall score of 6.8 ± 1.9 , which corresponds approximately to a rating of "like moderately." A frequency distribution of individual responses is shown in Figure 9. Only 20 of 50 Marines (40%) rated the carbohydrate gels "like very much" or "like extremely." Nine of 50 Marines (18%) gave the product a neutral or negative rating, or chose not to eat the product.

Figure 9. Frequency distribution for expected use during different training environments and overall like or dislike for total number of respondents.



WRITTEN COMMENTS OF VOLUNTEERS

Marines provided written comments on the likelihood that carbohydrate gels would be a valuable supplement to field rations. A total of 23 comments were offered. Three Marines felt that gels would be a good addition to current rations, but should not replace any ration item. Two Marines felt that gels were an easy way to get fast nourishment. An additional two Marines felt that putting protein in the gels was important. One Marine felt that this product would be good as a part of winter rations,

while another felt that the packaging and taste were good, and it was quick and easy to consume. Two Marines commented on brand preference, with Power Gel® being endorsed by one and GU® being endorsed by the other. There were also some negative comments concerning the use of gels. The following constructive or negative comments ($n = 1$ for each comment) were voiced:

- 1) If developed, would need to explain that you need to drink water with the gel; the branded packaging was valuable.
- 2) Would be a valuable supplement, but it doesn't taste very good.
- 3) Product was nasty, but ate it for the carbohydrates.
- 4) Product was good, but need to improve texture and flavor; it is hard to eat.
- 5) Don't need another package to leak in pockets.
- 6) This product will demoralize the troops.
- 7) This product is the worst.
- 8) Don't like the banana flavor.
- 9) Should make the product without having to tear off the top.
- 10) Leftovers are messy.
- 11) Product is too sweet.
- 12) Colored appearance isn't tactical.
- 13) Packing is not tactical.

DISCUSSION

Supplying supplemental carbohydrates to soldiers and Marines will increase their voluntary carbohydrate consumption (4,8,12). In a controlled laboratory study providing maltodextrin carbohydrate beverage during sustained physical activity, physical performance was improved by 16% in the carbohydrate beverage supplemented group (11). The Soldier Systems Center at Natick, MA, has developed a carbohydrate beverage powder (ERGO Drink) and a carbohydrate bar (HOOAH Bar), but carbohydrate gels have not yet been developed for military use. However, endurance athletes regularly use carbohydrate gels in endurance sports events such as marathons, triathlons, ultramarathons, and climbing and camping exercises for supplemental carbohydrates and energy. Carbohydrate gels are another alternative to drinks that may be useful in increasing carbohydrate intake of warfighters, and the study being reported represents an initial attempt to examine consumer preference regarding this product.

We evaluated the subjective utility and hedonic ratings of two of the more popular carbohydrate gel brands on the market (Power Gel® and GU®) by Marines undergoing a training exercise. This assessment was done to help determine the potential value of a carbohydrate gel as a supplement for military field rations. A total of 48 of 50 Marines tried some or all of the gels. The results of this evaluation during repeated days of field exercises suggest that there may be only moderate acceptability of carbohydrate gels as a ration supplement. Sweetness and flavor of gels were rated as moderately

acceptable, while texture, smell, and appearance of gels were rated as neither acceptable nor unacceptable. On average, the ratings for these gels were neutral or positive for overall acceptability. However, frequency distributions by the acceptability of each individual flavor showed that there were many Marines who did not find these gels acceptable.

When Marines were asked about gels in general, 18% found them not likeable. These proportions are considerably greater than the proportions of Marines who rated the likeability of either of the ERGO drink flavors tested (Lemon or Tropical Fruit) as neutral or less (less than 5%) using the same Likert-type scale used in this evaluation (7). Since not all Marines tried all flavors, the conclusions about flavor preferences should be viewed with caution. It is likely that response rates are biased by acceptability. From Figures 2 and 3 it may be seen that 46 out of the 50 Marines rated Power Gel® Strawberry-Banana while only 31 rated Power Gel® Chocolate. Hence, it is possible that 19 Marines would not even try the chocolate flavor. However, of those rating the various flavors, the flavor with the most number of Marines reporting positive ratings (i.e., greater than neutral) was GU® Chocolate, with 81% of Marines reporting favorable ratings, while GU® Plain had only 50% of Marines reporting favorable ratings. Therefore, the gel flavor that was most acceptable, GU® Chocolate, still had 19% of Marines not finding it likable, and 14 Marines that did not eat or rate it. The non-response rates and the disparity in rating scores show large individual differences with regard to these hedonic ratings.

When Marines were asked if they thought that carbohydrate gels would be a valuable supplement, 57% responded that they thought they would. However, when Marines were asked if the ERGO Drink would be a valuable supplement, 85% of Marines felt it would (7). If gels were provided as a supplement to rations, 41% of Marines said they were "extremely likely" to consume it, whereas 78% of Marines said they were "extremely likely" to consume the ERGO Drink if it was provided as a supplement (7). These results show that while carbohydrate gels may have some promise as a ration supplement, they do not compare favorably to the carbohydrate beverage powder (ERGO Drink). The evaluations of these two products used Marines as volunteers undergoing similar training and using the same survey, but were done during separate studies with different volunteers. Therefore, it is possible that the direct comparisons of the acceptability of the two products take this limitation into account. It is possible that certain environmental or operational conditions may have contributed to differences in ratings. A direct comparison in a controlled study using the same volunteers under the same conditions is necessary to determine more accurately the differences between products with regard to acceptability.

If carbohydrate gels were to be used, Marines suggested that a larger portion size be provided than those sampled. They also said they would accept a larger package size to accommodate a larger portion size. Ease of use and ease of opening the package were rated, on average, "very easy." Marines reported that they would most likely use carbohydrate gels when MREs are the primary food source. One concern would be what to do with disposing of the wrappers, especially if only part of

the portion was consumed. To replace an open package back in one's gear would be unsanitary, and a disposed wrapper in the field would be hazardous to the environment and, during combat, would be a marker to the enemy of one's previous position unless extraordinary care was taken to bury or hide the wrapper. Toothpaste-like tubes with caps were favored by 31% of respondents, while 60% liked the soft packaging as was provided. Perhaps toothpaste-like tubes would receive higher ratings if Marines had to carry used packages with them. As per instructions, carbohydrate gels should be taken with water to help dissolve the sticky mouth feel.

CONCLUSIONS

Carbohydrate gels were given only neutral to moderately favorable ratings. These ratings are considerably lower than those obtained in a previous assessment of the ERGO Drink. Some Marines however, did not like the product at all. The ease of use and ease of opening the package were positive attributes of the product. However, disposal of packaging and reuse of partially consumed product remain issues to be solved if gels are to be used as a ration supplement.

RECOMMENDATIONS

1. Carbohydrate gels were not well accepted by many Marines, and alternate forms of carbohydrate supplementation should also be considered.
2. Evaluation of gels using a re-sealable type tube should be performed if gels are to be adopted as a ration supplement.
3. Water should be available to drink when consuming carbohydrate gels.

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APPENDIX: CARBOHYDRATE GEL QUESTIONNAIRE

Gel Packet Acceptability Survey

MARKING INSTRUCTIONS

- Use a No. 2 pencil only.
- Do not use ink, ballpoint, or felt tip pens.
- Make solid marks that fill the response completely.
- Erase cleanly any marks you wish to change.
- Make no stray marks on this form.

CORRECT: ●

INCORRECT: ○~~○~~ ○~~○~~ ○~~○~~

ID NUMBER

0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

DATE

MONTH	DAY	YEAR
Jan		
Feb		
Mar	0 - 0	0 0 0 0
Apr	1 1	1 1 1 1
May	2 2	2 2 2 2
June	3 3	3 3 3 3
July	4 4	4 4 4 4
Aug	5 5	5 5 5 5
Sept	6 6	6 6 6 6
Oct	7 7	7 7 7 7
Nov	8 8	8 8 8 8
Dec	9 9	9 9 9 9

Product Acceptability

1. Using the scale below, please rate, overall, how much you liked or disliked the following aspects of the gel.

	Did Not Eat	Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither like nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely
Appearance	0	1	2	3	4	5	6	7	8	9
Flavor	0	1	2	3	4	5	6	7	8	9
Smell	0	1	2	3	4	5	6	7	8	9
Sweetness	0	1	2	3	4	5	6	7	8	9
Texture	0	1	2	3	4	5	6	7	8	9

Comment(s): _____

Do not write
in this box

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

2a. For **Power Gel**, please rate how much you liked or disliked the following flavor(s). Please fill in a bubble for each flavor.

	Did Not Eat	Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither like nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely
Chocolate	0	1	2	3	4	5	6	7	8	9
Vanilla	0	1	2	3	4	5	6	7	8	9
Lemon/Lime	0	1	2	3	4	5	6	7	8	9
Strawberry/Banana	0	1	2	3	4	5	6	7	8	9

What other flavors would you like? _____

Do not write
in this box

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

Gel Packet Acceptability Survey

ID Number _____

2b. For **GU**, please rate how much you liked or disliked the following flavor(s). Please fill in a bubble for each flavor.

	Did Not Eat	Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither like nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely
Chocolate	0	1	2	3	4	5	6	7	8	9
Vanilla	0	1	2	3	4	5	6	7	8	9
Orange	0	1	2	3	4	5	6	7	8	9
Banana	0	1	2	3	4	5	6	7	8	9
Berry	0	1	2	3	4	5	6	7	8	9
Plain	0	1	2	3	4	5	6	7	8	9

What other flavors would you like? _____

Do not write
in this box

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

Product Packaging

3. Using the scale below, please rate the package size.

Much Too Small	Somewhat Too Small	Just Right	Somewhat Too Large	Much Too Large
1	2	3	4	5

4. Using the scale below, please rate the ease of opening the package.

Extremely Difficult	Very Difficult	Moderately Difficult	Somewhat Difficult	Neither Easy	Somewhat Easy	Moderately Easy	Very Easy	Extremely Easy
1	2	3	4	5	6	7	8	9

5. Please rate the ease of using the product.

Extremely Difficult	Very Difficult	Moderately Difficult	Somewhat Difficult	Neither Easy	Somewhat Easy	Moderately Easy	Very Easy	Extremely Easy
1	2	3	4	5	6	7	8	9

Gel Packet Acceptability Survey

ID Number _____

6. Would you prefer the portion size to be:

Much Smaller	Quite A Bit Smaller	Moderately Smaller	Somewhat Smaller	Neither Smaller or Larger	Somewhat Larger	Moderately Larger	Quite A Bit Larger	Extremely Larger
1	2	3	4	5	6	7	8	9

7. What type of packaging would you prefer for this product? Please fill only one response.

Non-resealable Soft Package

Resealable Hard Package

Toothpaste-like tube

8. Would the carbohydrate gel be a valuable supplement to your field rations?

Extremely Unlikely	Very Unlikely	Moderately Unlikely	Somewhat Unlikely	Neither likely or unlikely	Somewhat Likely	Moderately Likely	Very Likely	Extremely Likely
1	2	3	4	5	6	7	8	9

Comments: _____

Do not write 0 1 2 3 4 5 6 7 8 9
in this box 0 1 2 3 4 5 6 7 8 9

Product Utility

9. Would you eat this item if it were available as a supplement to your field rations?

Extremely Unlikely	Very Unlikely	Moderately Unlikely	Somewhat Unlikely	Neither likely or unlikely	Somewhat Likely	Moderately Likely	Very Likely	Extremely Likely
1	2	3	4	5	6	7	8	9

10. Using the scale below, please rate how likely you would be to use this product during:

	Extremely Unlikely	Very Unlikely	Moderately Unlikely	Somewhat Unlikely	Neither likely or unlikely	Somewhat Likely	Moderately Likely	Very Likely	Extremely Likely
Garrison training	1	2	3	4	5	6	7	8	9
Field training:									
When field kitchen is available	1	2	3	4	5	6	7	8	9
When MRE is primary food source	1	2	3	4	5	6	7	8	9

11. Using the scale below, please rate how likely you would be to use the carbohydrate gel during:

	Extremely Unlikely	Very Unlikely	Moderately Unlikely	Somewhat Unlikely	Neither likely or unlikely	Somewhat Likely	Moderately Likely	Very Likely	Extremely Likely
Physical Activity	1	2	3	4	5	6	7	8	9
Rest Periods	1	2	3	4	5	6	7	8	9
Meal Time	1	2	3	4	5	6	7	8	9

Gel Packet Acceptability Survey

ID Number _____

12. Overall, how much do you like or dislike the carbohydrate gel?

Did Not Eat	Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither like nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely
0	1	2	3	4	5	6	7	8	9

13. What is your age today?

Please write your response in the blank boxes, then fill in the corresponding circles.

age	

1	2	3	4	5	6				
0	1	2	3	4	5	6	7	8	9

14. What is your gender?

M Male
F Female

15. Are you a nutritional supplement user?

Y Yes

N No (please go to question number 16)

Never/hardly

Once in a while

1-6 times per week

Once a day

Vitamins/minerals

Amino acids/protein (including creatine)

Herbal Preparations (e.g., ginseng, garlic, etc.)

Carbohydrate-Electrolyte Beverages

Carbohydrate Sports Bars

Carbohydrate Gels

Other _____

16. Do the current field rations meet your nutritional needs?

Y Yes (please go to question number 17)

N No

In NO, why not? _____

Do not write

0 1 2 3 4 5 6 7 8 9

in this box

0 1 2 3 4 5 6 7 8 9

Do not write

0 1 2 3 4 5 6 7 8 9

in this box

0 1 2 3 4 5 6 7 8 9

17. Do you think that nutritional supplements should be added to field rations?

Y Yes

N No

18. Do you think the carbohydrate gel could improve your performance?

Y Yes

N No

Do you have any suggestions for improving the product? _____

Do not write

0 1 2 3 4 5 6 7 8 9

in this box

0 1 2 3 4 5 6 7 8 9

Back Cover